India as a Destination of the R&D of Multinational Companies: Importance and Management Strategies of Local R&D Centers

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While R&D activities of multinational firms in India focus on offshore development, other companies are developing cutting-edge technologies in the country. Hence, product development for the local market has increased with the expansion of the Indian market. The importance of India as an R&D center is predicted to increase, and multinationals in advanced countries must improve the competency creation mission of R&D entities in India. To do so, attracting exceptional talent and running highly autonomous organizations with reduced control from headquarters are critical. However, within a corporate-wide innovation strategy, fostering unity through social controls, such as international personnel rotations and training, close communication, and permeation of the corporate culture, are essential to the effectiveness of the local entity.

Keywords: Multinational R&D, India, Division of innovative labor

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I. Introduction

As Japan and other advanced economies mature, economic growth in emerging countries shows high potential. This trend has become clearer with the financial crisis of 2008 and the recent Euro crisis. Accordingly, to capture emerging markets that are experiencing considerable growth,

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companies in advanced countries commonly engage in extensive research and development (R & D) activities. Among these markets, India is attracting attention, particularly among firms from Europe and the United States. Based on a United Nations Conference on Trade and Development (UNCTAD) survey, India ranks behind China and the United States as a top R & D center for multinational firms (UNCTAD 2005). When comparing China and India, many companies are attracted to the market and cheap labor of China, while the strength of India lies in its high-quality R & D resources. In particular, India boasts of the largest offshore centers for software, and many multinational firms have established information technology (IT)-related development offices there. In this paper, we focus on India as an international R & D center, and discuss management strategies for overseas R & D centers.

R & D internationalization is often categorized in two ways, which are activities that augment technological assets in the home country (home-base-augmenting or HBA) and activities that develop the market of the target country using the technological assets of the home country (home-base-exploiting or HBE) (Kuemmerle 1997). However, theories and empirical research regarding R & D internationalization have presumed R & D investments between advanced countries with relatively similar environments. When companies from advanced countries establish R & D centers in emerging countries, the vast differences between the business environments enable companies to select a strategy that capitalizes on these differences. In addition to the degree of adaptation to the local market (*i.e.*, aggregation *versus* adaptation), companies can utilize a new strategic axis of arbitrage (Ghemawat 2007) that takes advantage of the differences in business environments. A demonstrative example of this situation is the establishment of offshore development centers in emerging markets, particularly in India. Furthermore, a trend toward reverse innovation is emerging, where products developed in the emerging markets using uniquely local ideas are introduced to the home country (Immelt *et al.* 2009).

However, large differences in business environments are proportional to the difficulties in managing local R & D centers. For example, India has strict labor laws with active labor unions, the caste system, and different customs and practices by state. Moreover, weak intellectual property laws and high worker turnover lead to a high risk of technology leaks, which are sensitive factors in R & D and are usually highly confidential. By conducting R & D in India, companies can significantly improve efficiency, although a high risk of failure exists due to the un-

successful management of the research facilities. R & D management is critical because it is a high-risk/high-return investment.

In this paper, we provide an overview of technology management of overseas R & D centers by focusing on India as a host country. In the next section, we discuss the taxonomy of R & D globalization. While HBA and HBE are concepts created for R & D globalization in advanced countries, we summarize various activities that reflect R & D characteristics in emerging countries, including India. In Section III, we discuss the current state of R & D of foreign firms in India. In addition to providing an overall view using patent data, we discuss the market orientation of Suzuki Motors in developing new vehicles as well as examine the development of a portable electrocardiogram (ECG) device by GE Healthcare (a case of reverse innovation). In Section IV, we present a framework to understand dynamically the mission and positioning of foreign research centers as well as to discuss the state of management and organizational strategies for foreign R & D centers in India. Finally, we present our conclusions and discuss remaining issues.

II. Taxonomy of R&D Globalization

A. HBA and HBE

Various types of activities come to mind when discussing foreign R & D centers. These activities can be categorized into two types, namely, (1) a "technology acquisition" model, where overseas cutting-edge technologies are brought into domestic business, and (2) a "local development" model, where domestic technologies are localized into foreign business activities. The main difference between the two is the direction of technology and knowledge flow, which are critical to R & D. In the former, knowledge flows from the foreign country to the home country, while in the latter, the flow is reversed.

Kuemmerle (1997) termed the former as HBA and the latter as HBE. HBA holds true when a technology that is desirable to a company exists in the target market. For example, companies commonly establish research laboratories near Silicon Valley or Boston to capture cutting-edge technologies in IT or biotechnology. By contrast, in HBE, the size and characteristics of the market are more important than the level of technology in the target market. Products must be localized when local consumer needs differ from those of the home market. For example, in the Chinese market, companies establish local development centers to localize

home appliances, such as washers and dryers.

Cantwell and Mudambi (2005) focused on the knowledge flow and on the missions of local entities, and classified them into "competency-creating mandates" and "competency-exploiting mandates." Along with Kuemmerle (1997), this taxonomy follows the theories of Dunning (1996), who discussed whether the activities of local entities are aimed at acquiring strategic resources or whether they provide local market services, and others (Ghoshal and Bartlett 1990; Birkinshaw and Hood 1998; Frost *et al.* 2002) who debated whether they should be viewed as the overall corporate group's core research facilities or as local facilities responding to local needs. In other words, the taxonomy delves into governance issues within a global research organization by questioning the position of the local entity in the overall corporate group. Thus, local entities with competency creation missions are granted strategic autonomy. The autonomy of these local entities is critical in the formation of networks with local universities and corporations. Strong networks (embeddedness) with local companies that improve innovation capabilities are formed over time by local entities, and this process is not always appreciated at the headquarters (Anderson and Forsgren 2000). Convert-sely, forming local networks becomes difficult when headquarters exert strong control and the local entity is merely a branch office. Depending on the mission of global R&D centers, smooth knowledge flow is important between the headquarters and a local entity and between local entities and local institutions.

B. Taxonomy based on the State of R & D

Given the heterogeneous nature of R & D activities, the framework presented previously does not capture whole missions and the characteristics of overseas R & D centers in the real world. In this paper, we separately consider the concepts of R & D. "Research" has no inherent products or services, and denotes activities at a more abstract level. "Development" represents activities that aim for a specific output such as the creation of new products. Typically, these two areas are undertaken by different organizations within a company. For example, in the case of a general electronics manufacturer with multiple lines of business, such as computers, consumer electronics, and telecommunications devices, research is conducted by an organization such as an R & D headquarters or a central research laboratory that is not affiliated with a specific business unit. Development often takes place within business

units, such as a consumer electronics or telecommunications division. In the case of pharmaceutical companies, research generally refers to the stages leading up to the clinical trial phase, after which development takes over. The former is typically managed by an organization such as a research laboratory, while the latter is managed within, for example, a development headquarters. The decision to create separate R & D functions in an overseas entity is often analyzed in different sections within Japanese companies.

Next, we consider the growing importance of emerging countries as global R & D centers. The vast differences between the business environments of advanced and emerging countries can be used to a company's advantage, as in the case of offshore development. When a company based in an advanced country conducts R & D in an emerging country, HBE-style activities become possible. In this case, a company leverages technology resources from the home country and localizes them in local markets. However, HBE reduces the differences between products made based on home country specifications and local circumstances (*i.e.* adaptation), an activity different from a strategy that might capitalize on the disparity in wages (*i.e.* arbitrage), as in the case of offshore development. As a result of this difference between activities, a new strategic option has been added to expanding a home country product globally (aggregation) and localizing it (adaptation) (Ghemawat 2007). In other words, development aimed at local markets (adaptation) is conducted offshore (arbitrage).

By separating R & D and clearly identifying the position of target countries with differing business environments, we can deepen our understanding of the global R & D taxonomy (Figure 1). In addition to the traditional concepts of HBA and HBE, we present the following six classifications summarized by Gammeltoft (2006), who surveyed the latest case studies on global R & D expansion into emerging countries.

1. Technology driven: Acquiring local cutting-edge technology and monitoring technology trends;
2. Market driven: Incorporating local consumer needs and product localization;
3. Policy driven: Responding to various local regulations and R&D incentives and planning for local standardization of activities;
4. Production driven: Providing technology support for local production facilities;
5. Cost driven: Leveraging local and inexpensive labor;
6. Innovation driven: Acquiring local ideas for new products and

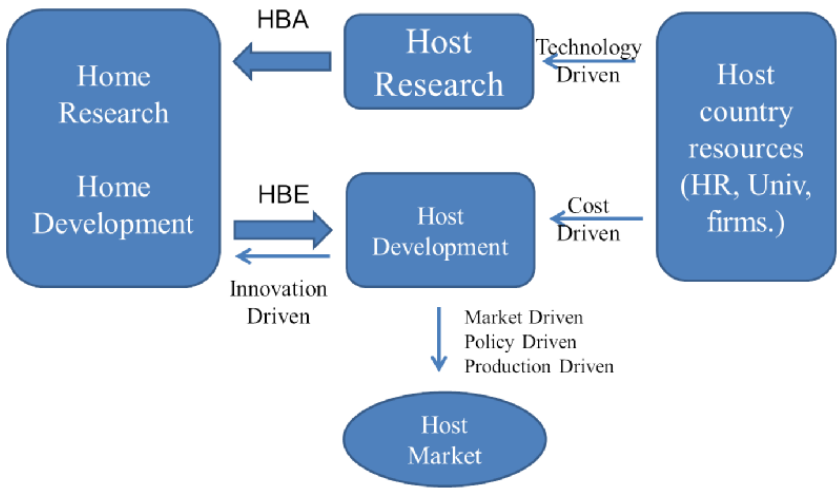


FIGURE 1
TAXONOMY OF R & D GLOBALIZATION

strengthening global product development infrastructure through optimal division of roles.

The traditional HBA model refers to research functions by which research capabilities in the home country are strengthened through foreign laboratories. Conversely, the HBE model refers to the localization of the development teams of products in target countries based on the technology of the home country.

This framework, however, simplifies the activities of various local R & D centers, and thus overlooks several important arguments. Of Gammeltoft's (2006) six classifications, "technology driven" can be viewed as a technology acquisition model (or an HBA-type model). The issue is with a local development model (or an HBE-type model), whose activities comprise a range of concepts. Of the six classifications, "market driven" is the closest. However, "policy driven" and "production driven" can also be generalized as local development models. With regard to the policy-driven model, responding to market needs and various standards is critical in localizing products. Many standards require localization with regard to, for example, environmental and safety regulations governing car exhausts, safety standards for cosmetics and pharmaceuticals, and electrical standards for electronics products. A company shipping products that do not meet these standards could cause accidents, and in

the case of noncompliance, the company is often linked with large damages that smear its brand image. In responding to such risks, following regulations and ensuring development and inspections to comply with standards are critical functions of local entities.

In optimizing local production processes, a production-driven model is a development function for localization, which is particularly important for car manufacturers. Manufacturing cars locally requires the creation of supply chains with local parts manufacturers. Of course, knockdown assembly of cars can be implemented by importing essential parts from Japan. However, when local content regulations make this difficult, increasing the procurement volume from local manufacturers is essential for reducing manufacturing costs. When using parts from local manufacturers, companies must conduct inspections to ensure that parts meet the standards demanded by car manufacturers. In emerging countries, such as China and India, finding parts complying with the standards of Japanese car manufacturers can be difficult. Thus, companies must alter production processes to attain the same level of quality in finished goods by using lower-quality products. Thus, local R & D is a necessity to achieve production processes that meet the conditions of the production facilities.

Furthermore, "cost-driven" and "innovation-driven" R & D are not part of technology acquisition and local development models. Cost-driven activities are equivalent to offshore development. R & D is a complex intellectual production activity, and for long, conducting R & D in emerging countries was not actively considered. However, countries, such as China and India, which are characterized by paying low wages and improving institutions of higher learning, annually produce high volumes of quality engineering personnel. Therefore, these countries have attracted foreign direct investments (FDI) by multinational firms as their offshore software development sites. This phenomenon has expanded to the design and development of electronic products, such as medical devices and telecommunications equipment. In addition, a cost-driven approach extends to research and is not confined to development. In Beijing, Microsoft established Microsoft Research Asia, which employs more than 300 researchers engaging in cutting-edge research. Meanwhile, IBM has research centers in Beijing, Delhi, and Bangalore. From a global perspective, these centers have an important role in R & D organization.

Finally, innovation-driven R & D activities focus on incorporating ideas from target countries into new product development processes. The business divisions of headquarters are often central to the development

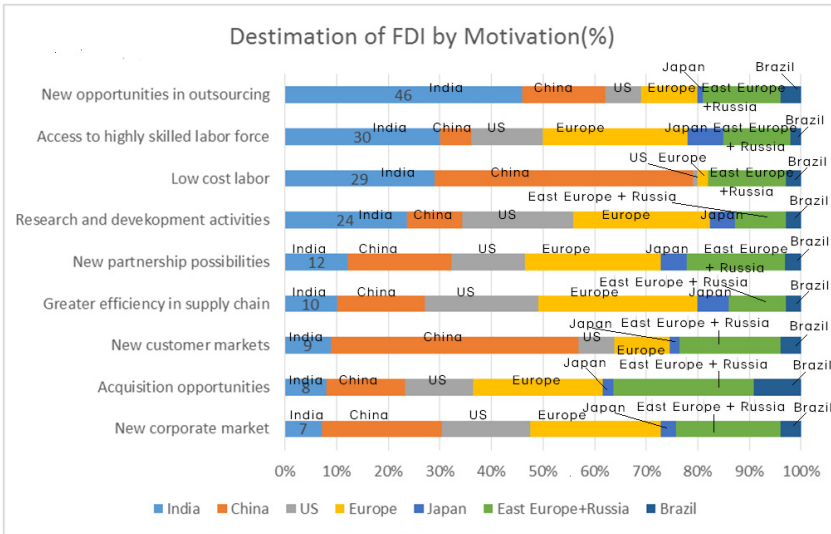
of global products, with overseas development centers positioned in support roles. However, products for local markets necessitate creativity at the local level. Innovation-driven activities define foreign development centers created with the expectation of reaping local innovation as well as new concepts and ideas. Leveraging product development ideas from emerging countries for global products will likely become more common in the future.

III. R & D in Multinational Firms in India

A. FDI Development in India

The history of foreign firms in India is not long. The management of the economy after gaining independence from Britain in 1947 kept the country extremely inaccessible. Until 1991, when new economic policies deregulated trade and direct investment, almost no activity by foreign firms was observed. In the automotive industry, Suzuki Motors was the exception. Suzuki was allowed to enter the Indian market in the 1980s through a joint venture with an Indian company. In the 1990s, GM, Ford, DaimlerChrysler, and Hyundai entered the market. In the late 1990s, the IT industry saw the creation of offshore centers for software development. IBM formed a sales company through a joint venture with the Tata Group in 1991. In 1999, the company formed IBM India as a wholly owned subsidiary, which created a structure that placed subsidiaries for software development and offshoring. GE has conducted business in India since its time as a British colony, although the company activities gained momentum only in the late 1990s. In 1997, GE established an offshore development center, and since the 2000s, the company has further energized its business with an eye on the Indian market.

The Indian government began providing incentives for foreign firms in earnest in the 2000s. As a British colony, India has a deep-rooted wariness with regard to foreign capital, and only allows gradual deregulation. At the outset of the 1990s, China began bringing in foreign capital, and by 2000, India was experiencing an average annual economic growth greater than 10%. By contrast, economic growth in India was stagnant at approximately half at 5.5%. Thus, galvanized by the steadily growing economy of its neighboring country through external liberalization, India undertook large-scale reforms of direct investment in 2002, apart from certain industries. Further deregulation occurred in 2005 in service industries, such as telecommunications, financial services, and real



Source: Chris O'Malley (2012)

FIGURE 2
ATTRACTIVENESS OF FDI DESTIMATION COUNTRIES

estate. In 2005, when special economic zones were established, foreign firms in various industries were allowed to create wholly owned subsidiaries and to receive tax incentives. Since 2006, the average economic growth has accelerated, and the country is expected to become an economic power in the 21st century. As a result, the activities of foreign firms have not been limited to offshore centers focused on global markets; they also focus on the Indian market itself.

Figure 2 shows the results of a survey, which was conducted in 2004 by the *Economist*, of 500 global executives on the most attractive countries in terms of globalization objectives (Economist Intelligence Unit 2004). India was deemed the most attractive location because of "new opportunities in outsourcing," as well as "access to a highly skilled labor force." These findings indicate that software resources in India are highly rated for their low cost and high quality. Overall, 24% of the executives listed R & D activities in India as being alongside those in Europe, the United States, and other advanced countries. From the perspective of foreign firms, India is highly attractive as an R & D destination. By contrast, China is attractive because of its low-cost labor and new customer markets, with only 11% of executives listing R & D

activities, which is less than half the percentage listed for India. This result reflects a belief in the R & D capabilities of India in software and pharmaceuticals, which are fields the country has competitive domestic companies.

B. R & D Activities of Foreign Firms

R & D activities of foreign firms in India gathered steam in 2000. IBM is a typical example. The company created the India Research Laboratory in 1998 as part of its global research facilities. In 2001, the company established the India Software Laboratory to conduct software-related R & D. In 2000, GE established the John F. Welch Technology Center (JFWTC) in Bangalore, with close to 4,000 researchers working on a variety of R & D activities. No formal statistics on R & D centers for foreign firms in India exists, although in 2010, the country had 471 companies with 649 research centers (Krishna *et al.* 2012).

Table 1 shows the total number of patents by company, based on the United States Patent and Trademark Office (USPTO), and registered between 2006 and 2010 by inventors living in India (Basant and Mani 2012). IBM leads the list, followed by Texas Instruments, GE, and others. Of the 15 companies, four are IT or telecommunications companies, five are semiconductor companies, three are software-related companies, and two are electronics-related companies, namely GE and Honeywell. The remaining company is Sabic Plastics (a chemical company based in Saudi Arabia). Many of the patents are software related. In addition, the companies are mostly from the United States, although European firms, such as ST Microelectronics and SAP, are also ranked. Japanese firms were slower to enter India than their European and US counterparts, with companies only recently creating research laboratories. For example, in 2010, the pharmaceutical manufacturer Eizai created a production process research center (Eizai Knowledge Center India) in the state of Andhra Pradesh. In 2011, Hitachi opened Hitachi India R & D Center in Bangalore. However, some companies have in-house R & D capability, such as Suzuki Motors, which conducts full-scale development of new cars in production facilities and not through independent R & D centers.

From the classifications shown in Figure 1, the R & D activities of these companies in India are likely to be cost driven. With Indian software engineers, companies can churn out software for product development at a global level. A high percentage of such activities are conduc-

TABLE 1
INDIAN INVENTIONS AND PATENTS (USPTO PATENTS)

1	IBM	IT	250
2	Texas Instruments	Semiconductor	211
3	GE	Medical devices	193
4	ST Microelectronics	Semiconductor	135
5	Honeywell Inc.	Electronics	93
6	Intel	Semiconductor	92
7	Cisco	Telecom equipment	91
8	Symantec	Software	91
9	Broadoom	Semiconductor	60
10	Hewlett-Packard	IT	57
11	Microsoft	Software	49
12	Sun Microsystems (*)	IT	43
13	Sabic Plastics	Chemicals	39
14	Freescale Semiconductors	Semiconductor	35
15	SAP	Software	31

Note (*): Sun Microsystems was bought out by Oracle in 2010.
Source: Basant and Mani (2012).

ted in India. However, akin to IBM Research India, certain companies with research groups in India position the country as a center for knowledge creation at a global level rather than for mere offshore development activities. GE's JFWTC employs approximately 4,000 staff, of which approximately 500 engage in research (Jin 2008). The research capabilities of universities and public research institutions are not particularly high. Therefore, companies do not absorb cutting-edge technology in India. However, the activities of utilizing outstanding personnel to pursue India-originated research output are technology driven. Intel created the Intel India Development Center in Bangalore as an important central processing unit (CPU) development center. The X86 Zeon microprocessor was developed in this center and was the first six-core chip produced by the company.

Economic growth in India has raised income levels and pushed market driven R & D for the local market. Though difficult to ascertain from patent data, some car manufacturers are developing passenger cars for the local market. Along with Indian income levels, the number of passenger cars sold in India is rapidly rising. In 2012, 2.77 million cars were sold, the fourth highest in the world behind China, the United States, and Japan. However, 80% of these vehicles are small cars that cost between $5,000 and $10,000 and requiring lower costs, in line

with market needs. In India, Suzuki Motors is particularly strong in the small-car market, in which it has a 40% share, and has long developed passenger cars for the local market through its local entity.

This type of market driven R&D is HBE, where the headquarters in the home country control the localization of technology for the local market. However, as HBE progresses, "local for local" activities arise, where products are developed for the local market through local initiatives. For example, GE Healthcare developed a portable ECG in JFWTC. Using ideas unique to India, JFWTC created a product that could be manufactured at one-third the cost of US products, and in a case of reverse innovation, the firm sold the portable ECG in the US market. This activity was a case of innovation-driven R&D, where local ideas are turned into products that expand the knowledge base of the headquarters in the home country. We discuss the cases of Suzuki Motors and GE Healthcare in greater detail in the following sections, as we explain the state of R&D activities in India.

C. Market driven R&D in Maruti Suzuki

Suzuki Motors entered the Indian market in 1982 through a joint venture with the nationalized car manufacturer Maruti Udyog Ltd. At that time, the Indian government did not allow domestic activities of foreign firms, and the joint venture was only realized at the behest of the Indian government. Suzuki Motors later increased its share in the joint venture (Maruti Suzuki), and in 2003, turned the joint venture into a wholly owned subsidiary concurrent with its listing on the Indian Stock Exchange. Based on the statistics by the Society of Indian Automobile Manufacturers, Maruti Suzuki produced 1.18 million cars in 2012, of which 120,000 were exported. The remaining 1.06 million cars were sold domestically. That year, 2.77 million cars were sold in India, which gave Suzuki the highest market share in the country at 38%.

Cars comprise thousands and even tens of thousands of parts, and thus paving the way for the emergence of manufacturers. Car manufacturers (assembly manufacturers) work directly with the largest of these manufacturers, where Tier 1 firms are supplied by many Tier 2 or Tier 3 suppliers. This situation represents a hierarchical structure characteristic of the industry. Producing cars in India requires the construction of a supply chain with these manufacturers.

For example, Denso is a Tier 1 supplier of electronic control units, fuel pumps, and injectors. Denso imports critical parts from Japan and

primarily engages in assembly in India. Although Tier 2 has some local procurement of resin and die cast parts, its suppliers in India are not mature. In addition, Japanese Tier 2 suppliers are mostly small- and medium-sized companies that have yet to enter the Indian market. "Cutting costs requires us to increase our local procurement, which is an important initiative for us, and the automakers are cooperative. We cannot decrease our quality, but we need to change our way of thinking by, for example, getting rid of some functionality to meet Indian market specifications" (from a 2011 interview with Denso India executives).

Car manufacturers, such as Suzuki Motors, and parts manufacturers, such as Denso, jointly achieve the development of low-cost cars meeting Indian specifications. For Denso to increase its procurement from local Tier 2 suppliers, the company must collaborate with Suzuki Motors on the functionality standards that must be met by the end-products. This type of collaboration furthers localization of production processes for Suzuki Motors and enables greater cost competitiveness for its products.

In addition, Maruti Suzuki continued developing an infrastructure to develop small cars in India. Until then, when the company introduced new models to the Indian market, it created local models based on those already developed and mass produced in Japan. However, the introduction of the Swift in 2005 transformed that modus operandi, with cars of the same quality and specification simultaneously produced in Japan, Hungary, India, and China. This policy further advanced in 2009, with the release of the A-Star. This car is a global model, produced in India, and it is not only sold in India but also exported to Europe. By periodically conducting exchanges among the engineers, Maruti Suzuki and Suzuki Motors in Japan continue to develop the infrastructure in India. Local design has three stages. The first stage is designing the front and rear body, specifically the shape of the lights and front grill. Maruti Suzuki has already reached this level. The second stage is designing the entire body. The final stage is developing the entire car, including the platform. According to a Maruti Suzuki staff, it "would like to be at stage two in a few years" (from a 2009 interview with Maruti Suzuki executives).

D. Reverse Innovation at GE Healthcare

The JFWTC is the research laboratory of GE in India. JFWTC employs 4,000 researchers and engineers and is one of the largest research centers of GE. Of the total number of employees, approximately 300

engineers develop products for GE Healthcare. As an example of innovation-driven R&D, we explain the concept of reverse innovation by examining the portable ECG developed at the JFWTC (Immelt *et al.* 2009; Govindarajan and Trimble 2012).

GE Healthcare held a high share of the global ECG market, although at prices between $3,000 and $10,000, the products were too expensive to be accepted in the Indian market. In addition, as patients in India were dispersed in areas not easily accessible by faster means of transportation, portability was critical. Furthermore, as certain locations did not have electric power, battery capabilities were necessary. GE Healthcare understood that existing products did not meet these market needs, and in response to these needs and to significantly reduce costs, it formed a new product development team at the JFWTC. In 2007, this team introduced the MAC400, an $800 portable ECG, into the market. Existing products had a digital signal processor, keyboard, and printer, which were all high-quality components that needed to be specially ordered. By contrast, the MAC400 used standard and low-cost components to reduce costs drastically. Moreover, the product was lightweight and battery operated, which made it popular in India. GE continued to further improve the product, and it is now sold in 60 countries, including the United States, as an entirely new product category. This example from GE Healthcare shows reverse innovation, where a product created through the initiative of a foreign R&D center spurs innovation globally and in the home country.

GE is a rare example of reverse innovation achieved by companies from advanced countries. However, we will likely see more instances of products from emerging countries spreading to other emerging countries, such as a product developed in India being sold in China. A 2009 survey by the Ministry of Economy, Trade, and Industry (METI) noted that the percentage of companies responding affirmatively to whether locally developed products will be supplied solely to the relevant country decreased from 55.6% five years ago to the current 28.2%. In addition, this number is predicted to decrease further to 9.3% in the next five years. Conversely, companies responding that they would supply locally developed products to the entire world remained at 14.6%. However, this number is predicted to increase to 35.2% in the next five years (METI 2010). Thus, the tendency is clear that products designed in emerging countries are developed not only for local markets but also for global markets.

However, many issues remain before this goal can be achieved.

Govindarajan and Timble (2012) noted that to be successful in an emerging country, companies from advanced countries must adopt a completely new approach to management. In addition, management must modify its views such that emerging countries can be positioned as core growth engines for the company because business environments in emerging countries can completely differ from those in advanced countries. In the ECG project of GE Healthcare, the company aimed to provide a product with 50% of the performance of existing products but at 15% of the price. This goal could not be achieved by merely improving existing products. Therefore, the company initiated a project to develop a new unique product in its Indian research laboratory.

Originally, GE Healthcare began with a local development project for a local market. Similar projects, although on a small scale, are likely to be found among global companies. For a product to be sold at a global level and for a project to attract investment of major resources, management views must undergo transformation. Senior management must decide whether it will concentrate serious efforts in emerging markets for the future growth of the company. In the case of GE Healthcare, company chairperson Jeffrey R. Immelt appointed a project leader who reported directly to him. This appointment helped overcome various internal and external obstacles and generated significant results.

However, high risks are involved in making substantial investments in a new region, where the business environment differs significantly from that in advanced countries. A management concern is the extent to which risk can be reduced in a high-risk/high-return investment. A project that is based in local markets and features new concepts does not imply that it should be managed entirely by the local subsidiary. Accordingly, companies can form local growth teams (LGT) that are highly independent, yet still report to senior management, as in the case of GE Healthcare. Effective measures include appointing personnel or organizations to bridge the home country and an emerging country, monitoring the progress of the LGT, and simultaneously considering locally generated ideas for new businesses and to share them with the entire company (Washburn and Hunsaker 2011).

IV. Organizational Management of Local R&D Centers

Among standard theories of international business management, the four types of global R & D organizations (Ghoshal and Bartlett 1990) are

as follows:

1. Center for global: The home country takes the lead in conducting R & D for global markets.
2. Local for local: Foreign research laboratories act independently in responding to local market needs.
3. Local for global: R & D for global markets is conducted in foreign research laboratories.
4. Globally linked: Multiple research laboratories in various countries collaborate in a network structure to work on a single project.

Determining the ideal type depends on the specifics of a project and company policy. In companies that primarily use Pattern 1, the role of foreign research facilities is minimal. This pattern may be effective for discovering and capturing cutting-edge technology, but it does not require a large-scale center. Pattern 1 is a centralized R & D management method where foreign research facilities work under the direction of the home country. Patterns 2 and 3 can be classified as decentralized management styles and require R & D centers of a scale that allows for some autonomy. For Pattern 2, R & D centers typically work as part of a larger organization in a particular region and are the most independent from the mother country among foreign R & D centers. By contrast, in Pattern 3, foreign centers often act under the control of the mother country in targeting global markets. Finally, in Pattern 4, companies have global R & D centers, with each having a particular role in pursuing corporate-wide projects. This pattern leads to classifications that go beyond "centralized" or "decentralized."

Tremendous risks in the globalization of R & D exist. A decrease in corporate-wide R & D efficiency due to failed management of foreign R & D facilities can shake the overall competitiveness of a company. Accordingly, foreign R & D centers are often created on a small scale, controlled by headquarters, and then gradually expand. Thus, the positioning of the local entity generally progresses sequentially from Patterns 1 to 4. In other words, companies do not abruptly start with a local for local or "local for global" local entity. Both conditions leave much to the discretion of the local entity. Taking the lead in creating the local entity and then gradually increasing its autonomy is more realistic for the R & D division at headquarters (Motohashi 2012).

Figure 3 graphically shows this evolutionary process for foreign research laboratories. The vertical axis shows the level of the competency

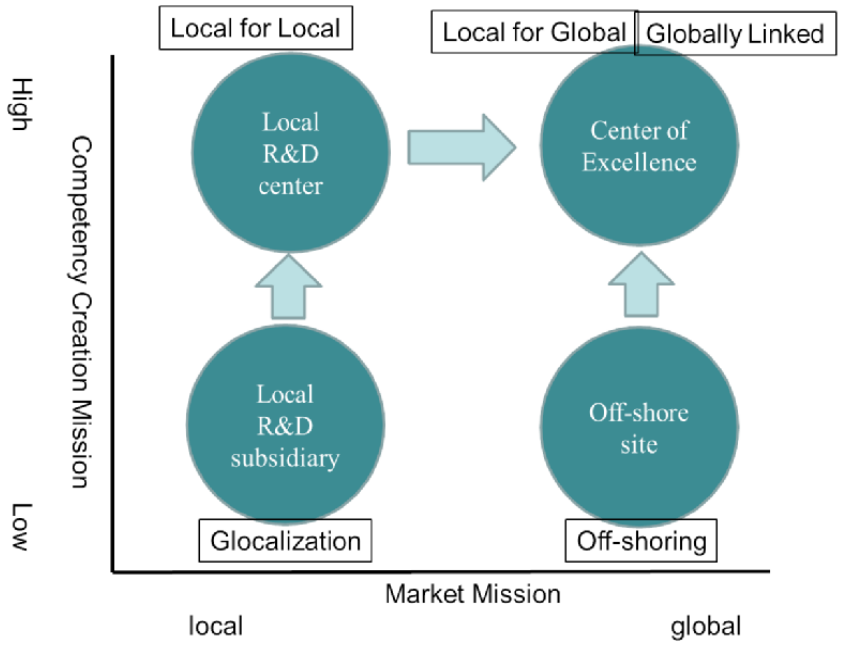


FIGURE 3
AN EVOLUTIONARY MODEL FOR FOREIGN RESEARCH LABS

creation mission for the local entity, and the horizontal axis shows whether the target market is local or global. The competency creation mission shows the importance of a local entity for a multinational firm in its knowledge creation activities at a global level (Cantwell and Mudambi 2005). The progression from Patterns 1 to 4 can be shown as a shift from local R & D subsidiaries to local R & D centers, and finally to centers of excellence (COEs). In this process, a company first increases its competency creation mission in accordance with specific local circumstances, and when the capabilities of the local entity have grown sufficiently, the company positions the local entity as part of the global R & D organization.

As discussed in Section III a characteristic of R & D organizations in India is the emphasis on their position as offshore development centers for the global market. The classification of Ghoshal and Bartlett (1990) was created when the internationalization of R & D activities was being implemented among advanced countries and cost-driven offshore development was not considered as an option. These offshore development

centers have their part in the R & D process locally under the direction of headquarters, making their competency creation mission low, although their target market is global (the bottom-right portion of Figure 3). However, R & D center activities for foreign firms in India are not limited to offshore development. The research laboratories in India of IBM and Microsoft have important roles in the global research networks of these companies. In addition, the Intel India Development Center develops cutting-edge CPUs. These research facilities are given a high competency creation mission and are placed in the COE quadrant. In other words, R & D centers in India can progress from being offshore sites to COEs.

Naturally, not all foreign R & D centers follow the path to becoming COEs, and for multinational firms to have COEs throughout the world is not even realistic. The level of a competency creation mission is determined by the global strategy of the multinational firm and the economic environment of the country in question (Cantwell and Mudambi 2005). India is blessed with an R & D environment characterized by outstanding software engineers, who facilitate the progression of its research facilities from being offshore sites to COEs. In addition, the acceleration of economic growth of India from 2000 onward has made the market attractive.

As a result, progression from local R & D sites to local R & D centers can be observed, as seen in the case of Suzuki Motors, and GE's JFWTC, which can be regarded as having evolved from a local R & D center to a COE. Increasing the competency creation mission of foreign R & D centers in India is essential to winning local and global competitions for innovation because of its growing importance in the supply and demand sides of R & D. Suzuki Motors and GE Healthcare have invested in India for long time, but the levels of local R & D centers, classified in Figure 3, are different. While GE's R & D center can be illustrated as an example of reverse innovation, Maruti Suzuki is still in the process of transitioning from a local R & D subsidiary to local R & D centers. Considering that new product development in the automotive industry requires more coordination of activities within and between firms, reaching the stage of "COE" takes more time than in the case of health care products. However, more autonomy to facilitate local innovation is imperative, even for the automotive industry, to capture the opportunity associated with the growing presence of emerging economies in global business.

To achieve this goal, multinational firms must accelerate the evolu-

tion of foreign research laboratories, as indicated on both axes in Figure 3. To increase the competency creation mission of local entities, companies must recruit outstanding personnel in the local entity and improve the quality of R & D activities. At the same time, companies must decentralize authority and increase the autonomy of local entities. Outputs from R & D activities are often uncertain, and the creativity of each researcher is essential (Kim *et al.* 2003). Accordingly, problems arise when headquarters exerts overwhelming control where researcher incentive is damaged and local knowledge cannot be fully leveraged. However, delegating authority to local entities can divert their activities from the company-wide mission. As observed on a global corporate-wide level, the risk of resources not being used effectively exists (Acemoglu *et al.* 2007). Thus, training local managers and rotating researchers between the local entities and headquarters are important countermeasures (Brickley *et al.* 2001). In addition, rather than formal mechanisms, such as regulations and compensation schemes, companies will deem it effective to work on social controls via close communication between headquarters and local entities as well as by sharing the corporate culture (Ecker *et al.* 2013).

V. Conclusion

In this paper, we reviewed Indian R & D activities of multinational firms from advanced countries and examined the state of organizational management in local R&D centers. India has an abundance of quality research personnel and a significant offshore development by US firms, particularly in the field of software. Moreover, companies, such as IBM, Intel, and GE conduct cutting-edge R & D in India. The economic growth and increasing income levels in India have made the Indian market attractive, and local R & D activities have been on the rise, particularly in the automotive market. Thus, India has world-class potential as a global R & D center that targets global markets and as a regional R & D hub for its local market and markets in emerging countries.

For multinational firms, realizing the high potential for innovation in India requires increasing the competency creation mission of local R & D centers. In doing so, companies must attract outstanding personnel to their local entities and provide a high level of autonomy by loosening the control from headquarters. In a corporate-wide innovation strategy, making the activities of local entities effective will require the engender-

ing of unity through social controls, such as international personnel rotation and training, close communication, and permeation of the corporate culture.

However, the economic and social environments of India significantly differ from those in Japan, the United States, and Europe. Although company headquarters in advanced countries may attempt to instill their corporate culture in India, this strategy is easier said than done. Accordingly, companies must create a management system in local entities with a high degree of transparency by using clear and formal rules and incentive systems. In addition, for the results of local R & D activities to be used as company-wide knowledge at a global level, companies must create a knowledge management system. Moreover, local R & D centers must assume the role of partners that link Indian universities and public research institutions. Harvesting local knowledge and technology into corporate-wide competency is critical. To share local intelligence throughout the company without stifling it, companies must adopt a flexible company-wide approach that accepts diversity. Although not discussed in this paper, the topic of how multinational firms should manage organizations should be explored in future studies.

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